NONLINEAR DYNAMICS OF CONTINUOUS MEDIA

Course No. 77728

Lecturer: Prof. Baruch Meerson

http://www.phys.huji.ac.il/∼meerson/

This course is intended for graduate students of physics. It gives an overview of nonlinear dynamic phenomena in space as described by continuum models. These models are usually formulated in terms of nonlinear differential equations in partial derivatives. The course introduces standard concepts of nonlinear dynamics of extended systems far from equilibrium, such as instability, traveling waves, self-similarity and dynamic scaling. The course includes home assignments. Among them there is a mandatory numerical project which comprises 25 points of the final grade. **Prerequisite: a course of hydrodynamics.**

Syllabus

Linear diffusion: a reminder. The Hopf equation and wave breaking. The Burgers equation and shock waves. The time-dependent Ginzburg-Landau equation: bistability and traveling fronts. The Fisher-Kolmogorov-Petrovsky-Piscounov equation: selection of the front speed and shape. Pulled and pushed fronts. Dimensional analysis and self-similarity of the first kind. Three stages of a strong explosion in a gas: radiation transfer, blast wave, relaxation. The role of initial conditions in traveling waves and self-similar solutions. The Barenblatt equation and self-similarity of the second kind. Phase-ordering dynamics with non-conserved and conserved order parameters. Models A and B and their sharp-interface limits. Ostwald ripening.

Literature

1. L.D. Landau and E.M. Lifshitz, *Fluid Mechanics*, 2nd edition (Pergamon, 1987).
2. A.S. Mikhailov, *Foundations of Synergetics*, vol. 1 (Springer-Verlag, 1994).
3. G.I. Barenblatt, *Scaling, Self-Similarity and Intermediate Asymptotics* (Cambridge University Press, 1996).
4. B. Meerson, Phys. Fluids A **1**, 887 (1989).
5. A. Bray, Advances in Physics **43**, 357 (1994).